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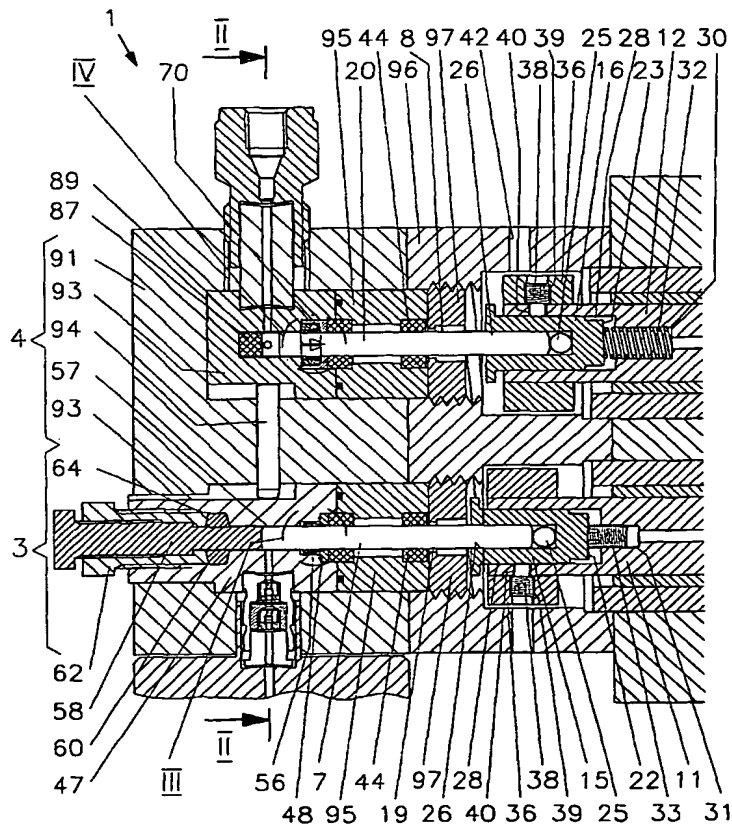
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(54) Title: HIGH-PRESSURE SMALL VOLUME PUMP



(57) Abstract: An improved high-pressure pump (1) for an accurate, largely pulsation-free flow of the working medium, more particularly an HPLC pump, includes one or a plurality of the following measures: reduced dead space due to adapted seals (48, 70); reduced dead space thanks to a device (15, 16; 32, 36, 38) for adjusting the length of the displacement piston; adjustable dead space and therefore adjusting capability of the pulsation freedom through a displacement chamber provided with an adjustable opposed piston (58); and seals compensating construction tolerances by a combination of a cambered sealing surface and a conical sealing surface.



— *before the expiration of the time limit for amending the claims and to be republished in the event of receipt of amendments*

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INTERNATIONAL SEARCH REPORT

International Application No

PCT/CH 03/00394

A. CLASSIFICATION OF SUBJECT MATTER
IPC 7 F04B53/16 F04B11/00 F04B53/14

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC 7 F04B

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

EPO-Internal, WPI Data, PAJ

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	EP 0 898 077 A (HYDRAIR LTD) 24 February 1999 (1999-02-24)	1
A	abstract page 3, line 14 -page 6, line 17 figures 1,2	2,3
X	US 3 981 620 A (ABRAHAMS LOUIS ET AL) 21 September 1976 (1976-09-21)	3,23
Y	abstract	20
A	column 6, line 16 - line 63 figures 4,5	1,4,5,13
Y	DE 43 08 467 A (FUNKE HERBERT DR) 5 May 1994 (1994-05-05)	20
A	cited in the application abstract column 1, line 1 - line 47 figures 1,2,6	1,3
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☒ Further documents are listed in the continuation of box C.

☒ Patent family members are listed in annex.

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- "A" document defining the general state of the art which is not considered to be of particular relevance
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Date of the actual completion of the international search

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INTERNATIONAL SEARCH REPORT

International Application No

PCT/CH 03/00394

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 4 706 970 A (RAMIREZ PEDRO) 17 November 1987 (1987-11-17) abstract column 3, line 4 -column 4, line 15 figures ---	1-4
A	US 4 592 558 A (HOPKINS JOHN F) 3 June 1986 (1986-06-03) abstract column 2, line 49 -column 4, line 67; figures ---	1-4
A	US 5 799 953 A (ENDERSON GARY L) 1 September 1998 (1998-09-01) abstract column 2, line 66 -column 5, line 25; figures ---	1-4
X	US 2 733 664 A (MILTON ROY COMPANY) 7 February 1956 (1956-02-07) column 2, line 31 -column 4, line 61; figures 1,2,9 ---	5,6 1,3,11, 13,16, 21,23
X	US 2 346 964 A (HARPER LYNDUS E) 18 April 1944 (1944-04-18) page 1, column 2, line 43 -page 4, column 2, line 70 figures ---	5,6,13, 14 16,17
X	EP 0 677 659 A (CRYOMEC AG) 18 October 1995 (1995-10-18) abstract column 2, line 49 -column 4, line 25 figure 1 ---	5,6 1,3,7, 11,21,23
A	US 2 841 092 A (BARRON JOHN T ET AL) 1 July 1958 (1958-07-01) column 2, line 6 -column 4, line 48 figure 1 ---	1,5,9, 13,16
A	US 4 045 343 A (ACHENER PIERRE Y ET AL) 30 August 1977 (1977-08-30) abstract column 9, line 4 -column 10, line 52 column 12, line 26 -column 13, line 2; figures 2,3 -----	1,3,13

INTERNATIONAL SEARCH REPORT

International application No.
PCT/CH 03/00394

Box I Observations where certain claims were found unsearchable (Continuation of Item 1 of first sheet)

This International Search Report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☐ Claims Nos.:
because they relate to subject matter not required to be searched by this Authority, namely:
2. ☐ Claims Nos.:
because they relate to parts of the International Application that do not comply with the prescribed requirements to such an extent that no meaningful International Search can be carried out, specifically:
3. ☐ Claims Nos.:
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

Box II Observations where unity of invention is lacking (Continuation of Item 2 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

see additional sheet

1. ☐ As all required additional search fees were timely paid by the applicant, this International Search Report covers all searchable claims.
2. ☒ As all searchable claims could be searched without effort justifying an additional fee, this Authority did not invite payment of any additional fee.
3. ☐ As only some of the required additional search fees were timely paid by the applicant, this International Search Report covers only those claims for which fees were paid, specifically claims Nos.:
4. ☐ No required additional search fees were timely paid by the applicant. Consequently, this International Search Report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

Remark on Protest

- ☒ The additional search fees were accompanied by the applicant's protest.
- ☐ No protest accompanied the payment of additional search fees.

FURTHER INFORMATION CONTINUED FROM PCT/ISA/ 210

This International Searching Authority found multiple (groups of) inventions in this international application, as follows:

1. Claims: 1-4,20,23

Hochdruckpumpe mit Federelement im Dichtelement

2. Claims: 5-10,11,12,21,22

Hochdruckpumpe mit Kolbenjustiereinrichtung
Hochdruckpumpe mit Gegenkolben

3. Claims: 13-19

Hochdruckpumpe mit lösbare Anschlussanordnung

INTERNATIONAL SEARCH REPORT

Information on patent family members

International Application No

PCT/CH 03/00394

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